

## **The biogeochemistry of gas generation from low-level nuclear waste: modelling after 18 years study under in situ conditions**

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The Gas Generation Experiment (GGE) located at the VLJ Repository for low and intermediate level waste (LLW/ILW) at Olkiluoto, Finland records the generation of a CH<sub>4</sub>-rich gas from LLW from the operating power plants. A description of the GGE that includes 16 200 dm<sup>3</sup> drums of cellulose containing LLW and results of the first 9 years of operation was published in [1]. We now present an 18 year set of geochemical and microbiological data from the GGE that has been interpreted with a biogeochemical model to examine how the chemical conditions in the experiment have evolved as a result of the microbiological processes occurring and where pH, Eh and carbonate have homogenised.

Initially, tank water in the experiment, which surrounds waste drums was buffered at pH 11 by a concrete overpack container. Neutralisation of the water to below pH 9 by cellulose degradation processes within the waste drums has resulted in a doubling of the rate of gas generation to around 1m<sup>3</sup> per year.

The model represents the coupled processes of organic waste degradation, pH buffering and microbial gas generation. The model simulates that the majority of the gas is formed by processes in the waste drums. The increase in gas generation corresponds to organic consuming methanogenic processes developing in the tank water after its pH falls below pH 9.

The study illustrates the complex coupled biogeochemical processes that affect gas generation and pH buffering of cementitious conditioned organic LLW/ILW, which has further implications for complexation and sorption processes that can affect radionuclide mobility.

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[1] Small et al (2008) *Appl. Geochem*, 23. 1383-1418.